# California High-Speed Rail Project


# Estimating High-Speed Train Operating & Maintenance Cost for the CA HSRA 2012 Business Plan

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**DRAFT**

The 2012 Business Plan presents a multi-step phased implementation strategy for the statewide high speed rail system. Four possible steps were costed: two initial operating segment (IOS) candidates (one North and one South), a Bay Area to Los Angeles Basin step completing both IOS candidates, and Phase 1 from San Francisco and Merced to Anaheim. As part of the Plan's development, 24 different scenarios of step sequencing, construction schedules, capital costs, operating and maintenance costs, and ridership and revenues were analyzed.

The first section presents the service levels for each step for both the high-speed train (HST) and connecting feeder services (conventional train and dedicated coach services). The second section presents the operating and maintenance (O&M) cost estimating methodology. The third section presents estimated staffing requirements for O&M activities. The fourth section presents the O&M cost estimates resulting from each scenario's assumed schedule of construction and start of service.

## 1. Service Levels for Implementation Steps

This section describes the service levels assumed for the four implementation steps costed, including both the high-speed train (HST) service and the connecting feeder coach and rail services at terminal stations. The service levels were established to meet the forecast demand in each of the years presented. The fifth year of each step's operation is shown, using the schedule of construction depicted in the main Business Plan report, in which either IOS opens in 2022, the Bay to the Basin is put in service in 2027, and Phase 1 starts up in 2034. In order to facilitate comparison among the steps, service levels are also presented for the year 2040; these levels also show how service would grow even if the HST system development did not occur on this schedule.

HST trainset miles were calculated for each service pattern by multiplying its frequency by the length of run, the number of trainsets per train (most are single trainsets), and adding 6% to 11% for non-revenue trainset operation (primarily operations without passengers to and from maintenance facilities for inspection, maintenance, and overnight storage). The sum of all services' trainset miles provided the figures used in Sections 3 and 4 below.

Dedicated feeder coach revenue-service hours were calculated similarly using the number of coaches needed and the length of time each run would take, based on traffic and operating characteristics such as projected levels of congestion and average operating speeds, and travel time estimates from online sources. Revenue service hours then were increased to total service hours using the same percentage as was used to increase each scenario's trainset revenue miles to total trainset miles.

Amtrak, Caltrain, and Metrolink timed connecting service was assumed to be provided by each operator adjusting prior operating schedules at no cost to the HST. Each operator also is assumed to retain the revenue generated on their service by the additional HST passengers.

*Initial Operating Segment North (IOS North)*

The IOS North step would provide HST service between San Jose and Bakersfield, and between Merced and Bakersfield. Caltrain, Amtrak, and dedicated coach services would provide coordinated connections to/from Sacramento, the Bay Area, and the LA Basin. Service levels assumed for HST and connecting services in year 2026 and 2040 are shown in Table 1 below.

**Table 1: IOS North service levels for HST and coordinated coach and rail connections**

| HST and Feeder Services | Daily Round Trips - 2026 | | | | Daily Round Trips - 2040 | | | |
|---|---|---|---|---|---|---|---|---|
| | Peak Hours[1] | Shoulder Hours[2] | Off-peak Hours[3] | Total Daily | Peak Hours[1] | Shoulder Hours[2] | Off-peak Hours[3] | Total Daily |
| **High Speed Train** | | | | | | | | |
| Between San Jose and Bakersfield | 4 | 4 | 14 | **22** | 6 | 6 | 16 | **28** |
| Between Merced and Bakersfield | 2 | 2 | 6 | **10** | 2 | 2 | 6 | **10** |
| **Connections** | | | | | | | | |
| **At San Jose** | | | | | | | | |
| Caltrain - San Francisco[4] | 4 | 4 | 24 | **32** | 4 | 4 | 24 | **32** |
| **At Merced** | | | | | | | | |
| Amtrak - Sacramento[4] | 1 | 1 | 1 | **3** | 1 | 1 | 1 | **3** |
| Amtrak - Oakland[4] | 2 | 2 | 3 | **7** | 2 | 2 | 3 | **7** |
| Turlock, Modesto, Stockton, Sacramento[5] | 2 | 2 | 6 | **10** | 2 | 2 | 6 | **10** |
| Dublin/Pleasanton, Oakland, San Francisco[5] | 2 | 2 | 6 | **10** | 2 | 2 | 6 | **10** |
| **At Bakersfield** | | | | | | | | |
| Palmdale[5] | 6 | 6 | 20 | **32** | 8 | 8 | 22 | **38** |
| Burbank Airport and LA Union Station[5] | 6 | 6 | 20 | **32** | 8 | 8 | 22 | **38** |
| San Fernando Valley, Van Nuys, and West LA[5] | 6 | 6 | 20 | **32** | 6 | 6 | 22 | **34** |
| San Fernando Valley and Santa Anita[5] | 6 | 6 | 0 | **12** | 6 | 6 | 0 | **12** |

1 Two hours each day, one in morning and in afternoon

2 Two hours each day, one in morning and in afternoon

3 12 hours each day

4 Coordinated schedules assumed

5 Dedicated Coach service provided by HST

*Initial Operating Segment South (IOS South)*

The IOS South step would provide HST service between Merced and a San Fernando Valley station, as an alternative starting step to the IOS North. Amtrak, Metrolink, and dedicated coach services would provide coordinated connections to/from Sacramento, the Bay Area, and other parts of the LA Basin. Service levels assumed for HST and connecting services in year 2026 and 2040 are shown in Table 2.

**Table 2: IOS South service levels for HST and coordinated coach and rail connections**

| HST and Feeder Services | Daily Round Trips - 2026 | | | | Daily Round Trips - 2040 | | | |
|---|---|---|---|---|---|---|---|---|
| | Peak Hours[1] | Shoulder Hours[2] | Off-peak Hours[3] | Total Daily | Peak Hours[1] | Shoulder Hours[2] | Off-peak Hours[3] | Total Daily |
| **High Speed Train** | | | | | | | | |
| Between Merced and San Fernando Valley | 8 | 8 | 21 | **37** | 8 | 8 | 23 | **39** |
| **Connections** | | | | | | | | |
| **At Merced** | | | | | | | | |
| Amtrak - Sacramento[4] | 1 | 1 | 1 | **3** | 1 | 1 | 1 | **3** |
| Amtrak - Oakland[4] | 2 | 2 | 3 | **7** | 2 | 2 | 3 | **7** |
| Turlock, Modesto, Stockton, Sacramento[5] | 8 | 8 | 21 | **37** | 8 | 8 | 23 | **39** |
| Dublin/Pleasanton, Oakland, San Francisco[5] | 8 | 8 | 21 | **37** | 8 | 8 | 23 | **39** |
| Gilroy, San Jose[5] | 8 | 8 | 21 | **37** | 8 | 8 | 23 | **39** |
| **At San Fernando Valley** | | | | | | | | |
| Metrolink - LA Union Station[4] | 4 | 4 | 12 | **20** | 4 | 4 | 12 | **20** |
| Burbank Airport and LA Union Station[5] | 8 | 8 | 21 | **37** | 8 | 8 | 23 | **39** |
| San Fernando Valley, Van Nuys, and West LA[5] | 4 | 4 | 12 | **20** | 4 | 4 | 12 | **20** |
| San Fernando Valley and Santa Anita[5] | 4 | 4 | 0 | **8** | 4 | 4 | 0 | **8** |

1 Two hours each day, one in morning and in afternoon

2 Two hours each day, one in morning and in afternoon

3 12 hours each day

4 Coordinated schedules assumed

5 Dedicated Coach service provided by HST

*Bay Area to LA Basin (Bay to Basin)*

The Bay to Basin step would provide HST service between San Jose and a San Fernando Valley station and between Merced and the San Fernando Valley station. Amtrak, Metrolink, Caltrain, and dedicated coach services would provide coordinated connections to/from Sacramento, and other parts of the LA Basin and the Bay Area. Service levels assumed for HST and connecting services in year 2031 and 2040 are shown in Table 3.

**Table 3: Bay to Basin service levels for HST and coordinated coach and rail connections**

| HST and Feeder Services | Daily Round Trips - 2031 | | | | Daily Round Trips - 2040 | | | |
|---|---|---|---|---|---|---|---|---|
| | Peak Hours[1] | Shoulder Hours[2] | Off-peak Hours[3] | Total Daily | Peak Hours[1] | Shoulder Hours[2] | Off-peak Hours[3] | Total Daily |
| **High Speed Train** | | | | | | | | |
| Between San Jose and San Fernando | 8 | 8 | 29 | **45** | 10 | 10 | 30 | **50** |
| Between Merced and San Fernando | 4 | 4 | 10 | **18** | 4 | 4 | 11 | **19** |
| **Connections** | | | | | | | | |
| **At San Jose** | | | | | | | | |
| Caltrain - San Francisco[4] | 4 | 4 | 24 | **32** | 4 | 4 | 24 | **32** |
| **At Merced** | | | | | | | | |
| Amtrak - Sacramento[4] | 1 | 1 | 1 | **3** | 1 | 1 | 1 | **3** |
| Amtrak - Oakland[4] | 2 | 2 | 3 | **7** | 2 | 2 | 3 | **7** |
| Turlock, Modesto, Stockton, Sacramento[5] | 2 | 2 | 6 | **10** | 2 | 2 | 6 | **10** |
| Dublin/Pleasanton, Oakland, San Francisco[5] | 2 | 2 | 6 | **10** | 2 | 2 | 6 | **10** |
| **At San Fernando Valley** | | | | | | | | |
| Metrolink - LA Union Station[4] | 4 | 4 | 12 | **20** | 4 | 4 | 12 | **20** |
| Burbank Airport and LA Union Station[5] | 12 | 12 | 26 | **50** | 14 | 14 | 41 | **69** |
| San Fernando Valley, Van Nuys, and West LA[5] | 9 | 9 | 16 | **34** | 10 | 10 | 28 | **48** |
| San Fernando Valley and Santa Anita[5] | 9 | 9 | 0 | **18** | 10 | 10 | 0 | **20** |

1 Two hours each day, one in morning and in afternoon

2 Two hours each day, one in morning and in afternoon

3 12 hours each day

4 Coordinated schedules assumed

5 Dedicated Coach service provided by HST

*San Francisco & Merced to Anaheim (Phase 1)*

The Phase 1 step would provide HST service between San Francisco and Anaheim, and between Merced and Los Angeles Union Station. Amtrak and dedicated coach services would provide coordinated connections to/from Sacramento, and other parts of the Bay Area. Service levels assumed for HST and connecting services in year 2038 and 2040 are shown in Table 4.

**Table 4: Phase 1 service levels for HST and coordinated coach and rail connections**

| HST and Feeder Services | Daily Round Trips - 2038 | | | | Daily Round Trips - 2040 | | | |
|---|---|---|---|---|---|---|---|---|
| | Peak Hours[1] | Shoulder Hours[2] | Off-peak Hours[3] | Total Daily | Peak Hours[1] | Shoulder Hours[2] | Off-peak Hours[3] | Total Daily |
| **High Speed Train** | | | | | | | | |
| Between San Francisco and Los Angeles | 4 | 4 | 12 | **20** | 4 | 4 | 12 | **20** |
| Between San Francisco and Anaheim | 6 | 6 | 36 | **48** | 6 | 6 | 36 | **48** |
| Between San Jose and Los Angeles | 4 | 4 | 0 | **8** | 4 | 4 | 0 | **8** |
| Between Merced and Los Angeles | 4 | 4 | 7 | **15** | 4 | 4 | 7 | **15** |
| **Connections** | | | | | | | | |
| **At Merced** | | | | | | | | |
| Amtrak - Sacramento[4] | 1 | 1 | 1 | **3** | 1 | 1 | 1 | **3** |
| Amtrak - Oakland[4] | 2 | 2 | 3 | **7** | 2 | 2 | 3 | **7** |
| Turlock, Modesto, Stockton, Sacramento[5] | 4 | 4 | 7 | **15** | 4 | 4 | 7 | **15** |

1 Two hours each day, one in morning and in afternoon

2 Two hours each day, one in morning and in afternoon

3 12 hours each day

4 Coordinated schedules assumed

5 Dedicated Coach service provided by HST

## 2. Operating & maintenance (O&M) cost estimating methodology

In order to quickly handle a large number of HST service scenarios, a simplified operating and maintenance (O&M) cost model was developed from the more complicated model used in the 2009 Report to the Legislature (2009 Report) and the ongoing project level environmental work (the earlier full model is described in Appendix 5-B of the Draft Merced to Fresno Section Project EIR/EIS[1]). The 2009 O&M costs were benchmarked against recent information from European and Japanese HST experience and from other studies, resulting in somewhat higher estimates than in earlier work in several categories. A method for estimating the O&M cost of inter-city bus services was developed to account for the significant amount of feeder coach service assumed for possible initial operable segments of the HST and extensions. Finally, a methodology was developed to match the HST and feeder service levels more precisely to the forecast ridership.

### a) Simplified HST O&M cost model

The simplified O&M cost model combines elements of cost in the 2009 Report that could reasonably vary by changes in a single variable such as train miles or route length. The cost categories of 2009 Report model and the aggregated categories of the simplified model are shown in Table 5, along with the variable that drives each respective cost category.

**Table 5 2009 and 2011 model categories**

| 2009 Model | | Simplified 2011 Model | |
|---|---|---|---|
| Category | Activity Driver | Category | Activity Driver |
| Train crew | Train & trainset hours | Train operations & maintenance | Trainset miles |
| Electric power | Trainset miles & station size | | |
| Trainset maintenance | Trainset miles | | |
| Maintenance of infrastructure | Route miles, capital cost | Same as 2009 | Route miles |
| Stations & train cleaning | Staffed by size & type | Same as 2009 | # stations |
| Sales, marketing, reservations | Staffed by station | Administration & support | % of cost except contingency |
| Control center | Staff estimate | | |
| Administration | Percent of operations labor | | |
| Insurance | Lump sum | Same as 2009 | Lump sum |
| Contingency | Percent of above | Same as 2009 | Percent of above |

[1] California High Speed Rail Program Management Team, "HST Operating and Maintenance Cost for Use in EIR/EIS Project Level Analyses". Memorandum to the Central Valley Regional Teams. July 11, 2011. Available on CA HSRA website at:http://208.82.222.137/pdfs/fresno_merced/vol_2/app_5b.pdf

The amount from each of the 2009 Report model categories was re-expressed in the form of the simplified model as shown in Table 6.

**Table 6 2009 Report cost by unit and group**

| | Data from 2009 Report (2009$$) | | | | |
|---|---|---|---|---|---|
| | Phase 1 Cost M) | Activity driver unit | Amount | Cost / unit | Cost / unit grouped |
| Train crew | $ 101.6 | TSM | 41.6 M | $ 2.36 | $ 17.98 |
| Electric power | $ 321.2 | TSM | | $ 7.45 | |
| Maintenance of equipment | $ 351.8 | TSM | | $ 8.17 | |
| Maintenance of infrastructure | $ 102.8 | RM | 520 | $200 K | $200 K |
| Stations & train cleaning | $ 57.4 | Station | 14 | $ 4.1 M | $4.1 M |
| Administration & support | $ 85.0 | % excl. cont. | 8% | 8% | 8% |
| Insurance | $ 50.0 | Lump sum | $50 M | $ 50 M | $50 M |
| Contingency | $ 53.5 | % of above | 5% | 5% | 5% |
| TSM = Train-set mile; RM = Route mile; K = thousands; M = millions | | | | | |

b) Benchmarking and updating unit costs for 2012 business plan

While many of the CA HST O&M costs are quite similar to U.S. conventional rail operations and can be reliably estimated from U.S. practices and costs, the cost to maintain high-speed trainsets and dedicated high-speed infrastructure has no close analogy in the U.S. The 2009 Report costs were based on activity levels for the French TGV system, adapted to the planned California operation and U.S. cost levels and labor practices. For the 2012 business plan, these items were compared to results reported for other high speed rail systems in Europe and Japan. European information was drawn from the International Union of Railways (UIC), a world-wide railroad association headquartered in Western Europe[2], published work by Spanish researchers[3], and a feasibility study of HST in Brazil conducted for the Inter-American Development Bank by a British/Chilean engineering and economics consortium.[4] Japanese costs for vehicle maintenance were reported by the Japan Railways Construction, Transport, and Technology Agency.[5]

[2] Union International des Chemins-de-Fer, "High-Speed Rail – Fast Track to Sustainability", Paris, France, 2010, online at http://www.uic.org/IMG/pdf/20101124_uic_brochure_high_speed.pdf

[3] Campos, de Rus, Barron, "Some stylized facts about high-speed rail around the world: an empirical approach", paper presented at 4th Annual Conference on Railroad Industry Structure, Competition and Investment, Universidad Carlos III de Madrid, October, 2006 cited in Halcrow/Sinergia, 2009.
Also similar work in: Campos , Javier, de Rus, Gines and Barron, Ignacio, "A review of HSR experiences around the world", Chapter 1 of "Economic Analysis Of High Speed Rail In Europe", BBVA Foundation, 2007, online at http://mpra.ub.uni-muenchen.de/12397/

[4] Halcrow/Sinergia Consortium, "Brazil TAV Project – Volume 4, Rail Operations and Technology, Part 1: Rail Operations", June, 2009 online at http://www.tavbrasil.gov.br/Documentacao/Ingles/VOL4-OPERATIONS&TECHNOLOGY/OPERATIONS/VOL_4_Pt_1_Operations_Final_Report.pdf

[5] Kikuchi, Kazunari, Japan Railway Construction, Transport and Technology Agency, "About the California High Speed Rail reviews for O & M (California High-Speed Rail O & M Review)", Attachment to e-mail Kikuchi to Hanakura, Yu, Sep. 2, 2011 (translated by Hanakura).

Table 7 shows the 2009 Report unit values for equipment and infrastructure maintenance in relationship to the overseas systems and studies. A comparison is instructive even though there are different categories of cost, and uncertainty from exchange rates and differences in standards of living. The 2009 maintenance of equipment costs for the CA HST, which were based on French TGV experience and include mid-life refurbishment costs, are higher but not out of line with the costs reported for the Japanese system. The UIC figure appears not to include amounts for the mid-life refurbishments of the trainsets, and the Halcrow/Sinergia study costs are factored downwards because of the lower cost of labor in Brazil. Because the CA HST trainsets will operate at higher speeds than those for which costs were reported and run more miles per year, and in order to add some further conservatism, the unit cost was increased 5% to $8.60 per trainset mile.

**Table 7 Comparison of 2009 CA HST maintenance costs with overseas HST costs (2009$$)**

| | CA HST 2009 | France | Spain | Japan | UIC Europe | Halcrow /Sinergia |
|---|---|---|---|---|---|---|
| Maintenance of equipment | | | | | | |
| (per trainset mile) | $ 8.17 | n.a. | n.a. | $7.20 | $4.16 | $5.75 |
| Maintenance of infrastructure | | | | | | |
| Track & systems (per route mile) | -- | -- | -- | n.a. | -- | $110,000 |
| Structures (per route mile) | -- | -- | -- | n.a. | -- | $90,000 |
| Total (per route mile) | $198,000 | $150,000 – 199,000 | $177,000 | n.a. | $145,000 | $200,000 |

The CA HST maintenance of infrastructure cost, also estimated in 2009 from French TGV line experience, is at the upper end of reported European experience and similar to the Halcrow/Sinergia study cost. Data for maintaining Japan's high speed lines was not uncovered. As a result of this review, the previous cost for infrastructure maintenance was rounded up to $200,000 per mile. The Halcrow/Sinergia study provided support for ramping up the maintenance of infrastructure cost over time to reflect that less maintenance is needed when the line is new, and that in later years it is more expensive as the system matures and replacement time nears. In the current CA HST model, costs start at a third of the average yearly maintenance cost, increase to the 25th year, as a capital renewal program begins to return the assets to new condition. Costs fall as the renewals are completed, and in the 35th year costs reach a cyclical low at two-thirds of the average cost and a new cycle begins.

CA HST energy consumption had been revised since 2009 by more comprehensive electric power load studies, bringing the electricity consumption to roughly 59 kWh per trainset mile including regenerative braking. To this has been added a 7% allowance for station and maintenance facilities electricity consumption. The cost of 17¢ / kWh used in 2009, which had been estimated from LA Metro costs with a three cent premium for "green power" added, was compared to that of the largest electric transit user in the state, the Bay Area Rapid Transit[6]. Their cost of 10.5¢ per kWh was substantially lower, and the base cost was lowered to the average of the two systems, and the three cent premium added for a total of 15.2 cents per kWh. The combined effect of these two changes was to increase the energy cost to $9.00 per train mile.

[6] Base Energy Inc. "Energy Efficiency Assessment of Bay Area Rapid Transit (BART) Train Cars". November 2007 online at http://www.bart.gov/docs/BARTenergyreport.pdf

The review found no reason to modify the train crew costs, but they were rounded up to $2.40 per trainset mile, from the prior $2.36. The sum of trainset mile related costs - crew, energy, and vehicle maintenance - thus totaled $20 as shown in Table 8.

The remaining cost categories in Table 8 were also reviewed. Administration and support was increased from 8% of all costs except contingency to 10% because the implementation steps are smaller with less activity over which to spread administration and support functions. Station costs were felt to be satisfactory and were not changed. Insurance was lowered to $25 million annually from $50 million after further review of costs for rail passenger service in the U.S. showed that the most expensive cost in 2010 was for the Los Angeles Metrolink system, at approximately $20 million a year. Finally, contingency was increased to 10% from 5% to provide more conservative estimates.

**Table 8 2009 and 2011 O&M model costs by category and unit**

| | | 2009 Report | 2011 Model |
|---|---|---|---|
| | Activity driver unit | Cost / unit (2009$$) | Cost / unit (2009$$) |
| Train crew, electric power, trainset maintenance | TSM | $17.98 | $20.00 |
| Maintenance of infrastructure | RM | $198 K | $200 K |
| Stations & train cleaning | Station | $ 4.1 M | $4.1 M |
| Administration & support | % excl. cont. | 8% | 10% |
| Insurance | Lump sum | $ 50 M | $25 M |
| Contingency | % of above | 5% | 10% |
| TSM = Train-set mile; RM = Route mile; K = thousands; M = millions | | | |

c) Estimating costs of feeder coach service

The initial operating segment and extensions require tightly coordinated feeder service in order to generate the range of ridership and revenue forecast. Most of this feeder service is envisaged as over-the-road coaches dedicated to the HS service, branded and marketed as an integral part of the HST. Other feeder service is assumed to be provided by Amtrak or Caltrain, also coordinated and co-marketed with the HST, but each operator is assumed to bear its operations cost and keep all revenue related to the segment of the trip made on its trains.

The cost of dedicated feeder coach service was estimated from a review of data and discussions with contract operators. In a recent study by Caltrans, rural intercity bus operations in the State were found to have costs per revenue service hour ranging from $40 to $117 per revenue service hour[7] with very light density service accounting for the upper end. Discussion with one intercity coach industry executive produced an estimate of around $65-$75 per revenue service hour, including the supply of coaches, operation, and establishment / operation of depot and maintenance facilities for a more intense service

[7] KFH Group, "California Statewide Rural Intercity Bus Study, Final Draft", Caltrans Division of Mass Transportation, 2007, table 3-9, online at http://www.dot.ca.gov/hq/MassTrans/Docs-Pdfs/5311/Bus-Study/Chapter-3.pdf .

as would be needed to meet HST trains.[8] For the2011 business plan, a cost of $92 per total (revenue and non-revenue) service hour (including 10% cost contingency) was used.

d) Matching operations frequency with forecast HST ridership

For each year of operations, the capacity of the proposed service was verified and, if necessary, adjusted to ensure sufficient capacity to carry the forecast traffic. This was done by first identifying the segment carrying the maximum traffic on each individual leg of the service, including conventional rail and/or dedicated bus service legs that serve as connections to the high speed train service. The average daily traffic volumes, provided by the traffic forecasts, were used to compute peak hour traffic volumes based on the hourly service patterns and on the ridership peaking factors identified in the Phase 1 Service Plan as shown in Table 9.

**Table 9 Ridership Peaking Factors**

| Origin-Destination Market | Peak Hour | Peak Shoulder Hour | 6 peak hours | 10 off-peak hours | Directional Peaking Factors | |
|---|---|---|---|---|---|---|
| | | | | | PM Peak South-bound | PM Peak North-bound |
| Inter-regional | 12% | 10% | 54% | 46% | 1.0 | 1.0 |
| Within MTC territory | 17% | 11% | 67% | 33% | 1.2 | 0.8 |
| Within SCAG territory | 15% | 10% | 61% | 39% | 0.9 | 1.1 |

Thereafter, the service levels required to carry the forecast hourly traffic were computed based on the capacity, load-factor, and minimum and maximum service level assumptions shown in Table 10. If the minimum service levels were found to have inadequate capacity to carry forecast traffic, the service frequencies were increased until adequate capacity was available. The service frequencies were assumed to be capped at the frequencies used for traffic forecast. If the forecast traffic exceeded the capacity of single trainsets at traffic forecast frequencies, it was assumed that double trainsets would be introduced, as needed.

**Table 10 Capacity, Load-factor, and Service Level Assumptions**

| Mode | Seating Capacity | Maximum Allowed Load Factor |
|---|---|---|
| High Speed Train | 500 passengers per single trainset | 90 percent of carrying capacity |
| Amtrak San Joaquins | | |
| Caltrain | | |
| Dedicated Buses | 30 passengers per coach | |

The resulting service frequencies and trainset requirements were then used to compute the O&M costs for each year of operations.

[8] Conversations with Stanley G. Feinsod, Chairman of the Board, MacDonald Transit Associates and Fullington Auto Bus Company, and business development advisor to RATP Dev USA.

## 3. Staffing Requirements

The staffing requirements for operating the service and maintaining the infrastructure and rolling stock were developed from the operating plan used for the operations and maintenance costing, U.S. and California labor practices and requirements, and overseas HST experience where needed. Staffing was first estimated for the 2009 Report to the Legislature ("Previous Phase 1" in Table 11), on the basis of the following functions and their labor requirements.

1. Operations: operate and dispatch the trains, manage the power supply and train routings, and serve the passengers on-board the trains. Staffing estimate assumed one driver per train and a four-member crew per trainset (i.e. eight-member crew for a double trainset), and the number of hours worked includes time spent driving and serving on the train, punching in, daily briefings, checking out the train, shut-down at the end of the day, training refreshers, time between trains and similar non-revenue service time.
2. Maintenance of Equipment: cleaning of trains, regular light and heavy maintenance of the trainsets in order to keep the fleet in safe operating condition and available for operations. Staffing estimate is based on two shifts a day for light maintenance throughout the facilities around the state, with additional staff for heavy overhauls at the heavy maintenance facility in the Central Valley.
3. Maintenance of Infrastructure: maintain the physical infrastructure including structures, bridges, buildings, tracks, signaling and communications systems, traction power system. Staffing estimate is based on ratios per mile of track or right of way. More labor intensive ballasted track was assumed throughout because the extent of slab track on the California high speed line has not been decided.
4. Passenger Services and Administration/Management: manage passenger services at stations such as ticketing and security, as well as general direction and management of the high speed rail system. Staffing estimate is based on 25 staff per shift for the five largest stations and 17 staff per shift for the remaining stations with three shifts for management and security staff, and two shifts of 10 hours for the remaining staff. Staffing for general management /administration is estimated at 10 percent of sum of all staffing identified above.

The above staffing levels were then applied to the year 2030, business case "high level of ridership and activity for Phase 1, Bay to Basin, and the initial operating segments steps, through interpolation/extrapolation on the basis of the values of the key driving factors. For the steady state year of 2040, the 2030 estimates were increased proportionally to the growth of ridership at 0.5% a year for the first three categories below; maintenance of infrastructure, which is a function of the length of the HST route, was not increased.

The sum of staffing required for the four labor categories provided the total staffing requirement. The total requirements (rounded-up to the nearest hundred) for steps the IOS North, IOS South, Bay to Basin, and Phase 1 steps under the low and capital cost with constrained construction schedule scenario are as shown in Table 11 below.

**Table 11: Driving Factors and Estimates for Staffing Requirements**

| | Previous Phase 1 (2030) | IOS North | IOS South | Bay to Basin | Current Phase 1 |
|---|---|---|---|---|---|
| Driving Factors | | | | | |
| System Length (in miles) | 540 | 300 | 300 | 450 | 540 |
| Annual Revenue Trainset Miles (in millions) | 42.0 | 7.2 | 9.4 | 20.5 | 34.8 |
| Number of Passengers (in millions) | 39.2 | 11.2 | 14 | 23.9 | 43.9 |
| Staffing Requirement | | | | | |
| Maintenance of Equipment | 2,100 | 400 | 500 | 1,100 | 1,800 |
| Maintenance of Infrastructure | 500 | 300 | 300 | 500 | 500 |
| Transportation Operations | 1,800 | 400 | 500 | 900 | 1,500 |
| Ancillary Services | 600 | 200 | 300 | 400 | 700 |
| **Total** | **5,000** | **1,300** | **1,600** | **2,900** | **4,500** |

## 4. O&M Costs for the 2012 Business Plan Scenarios

Using the methodology and assumptions described above, O&M cost projections were developed for each of the 24 scenarios consisting of combinations of capital cost, construction schedule, ridership and revenue, and operations and maintenance cost alternatives. The medium ridership and operating cost scenario provides a base case, and a sensitivity analysis of the low and high cost scenarios reveals the likely fluctuation in O&M cost projections if ridership and demand fluctuate.

For the two years prior to the start of each IOS, an allowance was provided for costs to hire and train the staff needed for operations, establish the administrative procedures, and run a test level of service. For the year immediately preceding the opening of service, the allowance was set at $150 million, (70% of the cost of the first full year of IOS North operation) and 2/3rds of that for the prior year. Hiring and training costs for extending service to Bay to Basin and Phase 1 are assumed to be covered in the normal operating cost of HST.

## IOS NORTH - CONSTRAINED CONSTRUCTION SCHEDULE - HIGH CONSTRUCTION COSTS

**HIGH, MEDIUM, AND LOW RIDERSHIP, REVENUE, AND OPERATING AND MAINTENANCE COSTS**
**SCENARIOS 01, 02, AND 03**

**SERVICE PARAMETERS**

| | Route Miles | Revenue Service Start | HST Trainset Miles (in millions per year) | | | Dedicated Coach Hours (in millions per year) | | |
|---|---|---|---|---|---|---|---|---|
| | | | High | Medium | Low | High | Medium | Low |
| IOS North | 300 | 2023 | 7.8 | 6.6 | 5.6 | 0.8 | 0.6 | 0.5 |
| Bay to Basin | 450 | 2028 | 21.8 | 18.1 | 14.8 | 0.3 | 0.2 | 0.2 |
| Phase 1 | 540 | 2039 | 29.9 | 24.4 | 20.6 | 0.2 | 0.2 | 0.1 |

Note: HST Trainset Miles and Dedicated Coach Hours are for Year 2040

**HIGH RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 01**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | - | 4.4 | 5.8 | 7.3 | 8.8 | 10.4 | 15.2 | 17.1 | 19.1 | 23.3 | 34.9 | 45.0 | 46.2 | 47.4 | 48.5 |
| **Revenue (in 2010 $$)** | - | - | - | 289 | 386 | 485 | 586 | 689 | 1,111 | 1,253 | 1,397 | 1,702 | 2,154 | 2,780 | 2,851 | 2,923 | 2,996 |
| **Revenue (in YoE $$)** | - | - | - | 424 | 584 | 756 | 941 | 1,139 | 1,892 | 2,196 | 2,523 | 3,563 | 5,229 | 7,824 | 9,299 | 11,052 | 13,136 |
| **O&M Costs (in 2010 $$)** | - | 100 | 150 | 216 | 260 | 304 | 345 | 380 | 538 | 603 | 647 | 778 | 1,004 | 1,230 | 1,267 | 1,272 | 1,271 |
| Ops. and Maint. Of Equipment | - | - | - | 88 | 121 | 154 | 184 | 210 | 310 | 359 | 390 | 468 | 637 | 804 | 828 | 857 | 876 |
| Maint. Of Infrastructure | - | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 69 | 109 | 128 | 135 | 110 | 90 |
| Stations | - | - | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | - | 17 | 20 | 23 | 26 | 29 | 41 | 46 | 50 | 60 | 83 | 102 | 105 | 105 | 105 |
| Contingency | - | - | - | 19 | 22 | 26 | 29 | 32 | 46 | 51 | 55 | 66 | 91 | 112 | 115 | 116 | 116 |
| Caltrain Fare Reimbursement | - | - | - | 12 | 16 | 20 | 24 | 29 | 37 | 42 | 46 | 57 | - | - | - | - | - |
| Start-up Training | - | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | - | 138 | 214 | 317 | 393 | 474 | 553 | 628 | 916 | 1,057 | 1,169 | 1,629 | 2,436 | 3,461 | 4,132 | 4,810 | 5,573 |

**MEDIUM RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 02**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | - | 3.7 | 4.9 | 6.2 | 7.4 | 8.7 | 12.7 | 14.3 | 16.0 | 19.5 | 29.2 | 37.7 | 38.7 | 39.7 | 40.7 |
| **Revenue (in 2010 $$)** | - | - | - | 246 | 326 | 408 | 492 | 577 | 931 | 1,049 | 1,170 | 1,425 | 1,804 | 2,329 | 2,387 | 2,448 | 2,509 |
| **Revenue (in YoE $$)** | - | - | - | 361 | 494 | 636 | 789 | 954 | 1,584 | 1,839 | 2,113 | 2,984 | 4,379 | 6,552 | 7,788 | 9,256 | 11,001 |
| **O&M Costs (in 2010 $$)** | - | 100 | 150 | 208 | 235 | 266 | 312 | 343 | 460 | 513 | 550 | 681 | 864 | 1,068 | 1,107 | 1,087 | 1,112 |
| Ops. and Maint. Of Equipment | - | - | - | 83 | 102 | 125 | 160 | 183 | 250 | 290 | 316 | 395 | 521 | 670 | 696 | 704 | 745 |
| Maint. Of Infrastructure | - | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 69 | 109 | 128 | 135 | 110 | 90 |
| Stations | - | - | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | - | 16 | 18 | 21 | 24 | 26 | 35 | 39 | 42 | 52 | 71 | 88 | 92 | 90 | 92 |
| Contingency | - | - | - | 18 | 20 | 23 | 26 | 29 | 39 | 43 | 46 | 58 | 79 | 97 | 101 | 99 | 101 |
| Caltrain Fare Reimbursement | - | - | - | 10 | 14 | 17 | 21 | 24 | 31 | 35 | 39 | 47 | - | - | - | - | - |
| Start-up Training | - | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | - | 138 | 214 | 305 | 355 | 414 | 501 | 567 | 783 | 899 | 994 | 1,425 | 2,098 | 3,005 | 3,612 | 4,110 | 4,877 |

**LOW RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 03**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | - | 3.1 | 4.0 | 5.0 | 6.0 | 7.0 | 10.3 | 11.6 | 12.9 | 15.7 | 23.6 | 30.4 | 31.2 | 32.0 | 32.8 |
| **Revenue (in 2010 $$)** | - | - | - | 203 | 267 | 331 | 398 | 465 | 750 | 845 | 943 | 1,149 | 1,454 | 1,877 | 1,924 | 1,973 | 2,023 |
| **Revenue (in YoE $$)** | - | - | - | 298 | 403 | 516 | 638 | 769 | 1,277 | 1,483 | 1,703 | 2,405 | 3,530 | 5,281 | 6,277 | 7,460 | 8,867 |
| **O&M Costs (in 2010 $$)** | - | 100 | 150 | 193 | 208 | 231 | 261 | 296 | 406 | 446 | 467 | 574 | 764 | 948 | 966 | 936 | 924 |
| Ops. and Maint. Of Equipment | - | - | - | 72 | 82 | 99 | 121 | 148 | 211 | 241 | 254 | 315 | 439 | 571 | 579 | 579 | 590 |
| Maint. Of Infrastructure | - | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 69 | 109 | 128 | 135 | 110 | 90 |
| Stations | - | - | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | - | 15 | 16 | 18 | 20 | 23 | 31 | 35 | 36 | 44 | 63 | 78 | 80 | 77 | 76 |
| Contingency | - | - | - | 17 | 18 | 20 | 22 | 25 | 35 | 38 | 40 | 49 | 69 | 86 | 88 | 85 | 84 |
| Caltrain Fare Reimbursement | - | - | - | 8 | 11 | 14 | 17 | 19 | 25 | 28 | 31 | 38 | - | - | - | - | - |
| Start-up Training | - | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | - | 138 | 214 | 283 | 315 | 361 | 419 | 490 | 690 | 783 | 844 | 1,203 | 1,855 | 2,668 | 3,151 | 3,539 | 4,052 |

YoE = Year of Expenditure, inflation rate of 3% per annum

## IOS NORTH - UNCONSTRAINED CONSTRUCTION SCHEDULE - HIGH CONSTRUCTION COSTS

**HIGH, MEDIUM, AND LOW RIDERSHIP, REVENUE, AND OPERATING AND MAINTENANCE COSTS**
**SCENARIOS 04, 05, AND 06**

**SERVICE PARAMETERS**

| | Route Miles | Revenue Service Start | HST Trainset Miles (in millions per year) | | | Dedicated Coach Hours (in millions per year) | | |
|---|---|---|---|---|---|---|---|---|
| | | | High | Medium | Low | High | Medium | Low |
| IOS North | 300 | 2021 | 7.8 | 6.8 | 5.8 | 0.8 | 0.6 | 0.5 |
| Bay to Basin | 450 | 2026 | 21.8 | 18.1 | 14.8 | 0.3 | 0.2 | 0.2 |
| Phase 1 | 540 | 2034 | 36.9 | 31.1 | 25.6 | 0.3 | 0.2 | 0.2 |

Note: HST Trainset Miles and Dedicated Coach Hours are for Year 2040

**HIGH RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 04**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | **-** | **4.3** | **5.7** | **7.2** | **8.7** | **10.2** | **14.9** | **16.8** | **18.7** | **20.7** | **22.7** | **34.0** | **43.9** | **45.0** | **46.2** | **47.4** | **48.5** |
| **Revenue (in 2010 $$)** | **-** | **283** | **379** | **476** | **575** | **676** | **1,089** | **1,228** | **1,369** | **1,513** | **1,660** | **2,101** | **2,712** | **2,780** | **2,851** | **2,923** | **2,996** |
| **Revenue (in YoE $$)** | **-** | **392** | **540** | **698** | **869** | **1,052** | **1,748** | **2,030** | **2,331** | **2,653** | **2,998** | **4,400** | **6,583** | **7,824** | **9,299** | **11,052** | **13,136** |
| **O&M Costs (in 2010 $$)** | **150** | **216** | **259** | **303** | **341** | **368** | **536** | **564** | **640** | **670** | **750** | **967** | **1,196** | **1,240** | **1,263** | **1,259** | **1,271** |
| Ops. and Maint. Of Equipment | - | 88 | 121 | 154 | 182 | 201 | 309 | 328 | 384 | 403 | 461 | 623 | 785 | 804 | 828 | 857 | 876 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 17 | 20 | 23 | 26 | 28 | 41 | 43 | 49 | 51 | 57 | 80 | 99 | 103 | 104 | 104 | 105 |
| Contingency | - | 19 | 22 | 26 | 29 | 31 | 45 | 48 | 54 | 56 | 63 | 88 | 109 | 113 | 115 | 114 | 116 |
| Caltrain Fare Reimbursement | - | 12 | 16 | 20 | 24 | 28 | 36 | 41 | 46 | 50 | 55 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | **202** | **299** | **370** | **445** | **516** | **574** | **861** | **933** | **1,089** | **1,174** | **1,354** | **2,026** | **2,903** | **3,490** | **4,119** | **4,763** | **5,570** |

**MEDIUM RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 05**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | **-** | **3.6** | **4.8** | **6.0** | **7.3** | **8.5** | **12.5** | **14.1** | **15.7** | **17.3** | **19.0** | **28.5** | **36.8** | **37.7** | **38.7** | **39.7** | **40.7** |
| **Revenue (in 2010 $$)** | **-** | **241** | **320** | **400** | **482** | **566** | **912** | **1,028** | **1,147** | **1,267** | **1,390** | **1,760** | **2,271** | **2,329** | **2,387** | **2,448** | **2,509** |
| **Revenue (in YoE $$)** | **-** | **334** | **456** | **588** | **729** | **881** | **1,464** | **1,700** | **1,952** | **2,222** | **2,511** | **3,685** | **5,513** | **6,552** | **7,788** | **9,256** | **11,001** |
| **O&M Costs (in 2010 $$)** | **150** | **207** | **234** | **265** | **300** | **337** | **459** | **494** | **549** | **589** | **644** | **845** | **1,047** | **1,078** | **1,084** | **1,055** | **1,093** |
| Ops. and Maint. Of Equipment | - | 82 | 102 | 125 | 150 | 179 | 250 | 275 | 316 | 343 | 381 | 521 | 662 | 670 | 681 | 688 | 730 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 16 | 18 | 21 | 23 | 26 | 35 | 38 | 42 | 45 | 49 | 70 | 87 | 89 | 90 | 87 | 90 |
| Contingency | - | 18 | 20 | 23 | 25 | 29 | 39 | 42 | 46 | 50 | 54 | 77 | 95 | 98 | 99 | 96 | 99 |
| Caltrain Fare Reimbursement | - | 10 | 13 | 17 | 20 | 24 | 30 | 34 | 38 | 42 | 46 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | **202** | **286** | **334** | **390** | **453** | **526** | **737** | **817** | **935** | **1,034** | **1,164** | **1,769** | **2,542** | **3,033** | **3,537** | **3,991** | **4,791** |

**LOW RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 06**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | **-** | **3.0** | **3.9** | **4.9** | **5.9** | **6.9** | **10.1** | **11.3** | **12.6** | **14.0** | **15.3** | **23.0** | **29.7** | **30.4** | **31.2** | **32.0** | **32.8** |
| **Revenue (in 2010 $$)** | **-** | **199** | **261** | **325** | **390** | **456** | **735** | **829** | **924** | **1,021** | **1,121** | **1,418** | **1,831** | **1,877** | **1,924** | **1,973** | **2,023** |
| **Revenue (in YoE $$)** | **-** | **275** | **373** | **477** | **590** | **710** | **1,180** | **1,370** | **1,573** | **1,791** | **2,024** | **2,970** | **4,443** | **5,281** | **6,277** | **7,460** | **8,867** |
| **O&M Costs (in 2010 $$)** | **150** | **189** | **208** | **231** | **255** | **296** | **404** | **439** | **458** | **496** | **554** | **731** | **902** | **952** | **955** | **917** | **924** |
| Ops. and Maint. Of Equipment | - | 69 | 82 | 99 | 117 | 148 | 210 | 235 | 247 | 272 | 314 | 428 | 542 | 566 | 574 | 574 | 590 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 15 | 16 | 18 | 20 | 23 | 31 | 34 | 35 | 38 | 43 | 60 | 75 | 79 | 79 | 76 | 76 |
| Contingency | - | 16 | 18 | 20 | 22 | 25 | 35 | 37 | 39 | 42 | 47 | 66 | 82 | 87 | 87 | 83 | 84 |
| Caltrain Fare Reimbursement | - | 8 | 11 | 14 | 16 | 19 | 24 | 28 | 31 | 34 | 37 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | **202** | **262** | **296** | **339** | **385** | **461** | **649** | **726** | **780** | **870** | **1,001** | **1,531** | **2,188** | **2,678** | **3,115** | **3,466** | **4,049** |

YoE = Year of Expenditure, inflation rate of 3% per annum

## IOS NORTH - CONSTRAINED CONSTRUCTION SCHEDULE - LOW CONSTRUCTION COSTS

**HIGH, MEDIUM, AND LOW RIDERSHIP, REVENUE, AND OPERATING AND MAINTENANCE COSTS**
**SCENARIOS 07, 08, AND 09**

**SERVICE PARAMETERS**

| | Route Miles | Revenue Service Start | HST Trainset Miles (in millions per year) | | | Dedicated Coach Hours (in millions per year) | | |
|---|---|---|---|---|---|---|---|---|
| | | | High | Medium | Low | High | Medium | Low |
| IOS North | 300 | 2022 | 7.8 | 6.6 | 5.6 | 0.8 | 0.6 | 0.5 |
| Bay to Basin | 450 | 2027 | 21.8 | 18.1 | 14.8 | 0.3 | 0.2 | 0.2 |
| Phase 1 | 540 | 2034 | 36.9 | 31.1 | 25.6 | 0.3 | 0.2 | 0.2 |

Note: HST Trainset Miles and Dedicated Coach Hours are for Year 2040

**HIGH RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 07**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | 4.3 | 5.8 | 7.2 | 8.7 | 10.3 | 15.0 | 17.0 | 18.9 | 20.9 | 34.0 | 43.9 | 45.0 | 46.2 | 47.4 | 48.5 |
| **Revenue (in 2010 $$)** | - | - | 286 | 382 | 480 | 580 | 682 | 1,100 | 1,240 | 1,383 | 1,528 | 2,101 | 2,712 | 2,780 | 2,851 | 2,923 | 2,996 |
| **Revenue (in YoE $$)** | - | - | 408 | 561 | 727 | 904 | 1,095 | 1,818 | 2,111 | 2,425 | 2,760 | 4,400 | 6,583 | 7,824 | 9,299 | 11,052 | 13,136 |
| **O&M Costs (in 2010 $$)** | 100 | 150 | 227 | 260 | 303 | 344 | 380 | 537 | 599 | 646 | 693 | 958 | 1,190 | 1,239 | 1,270 | 1,267 | 1,270 |
| Ops. and Maint. Of Equipment | - | - | 97 | 121 | 154 | 184 | 210 | 309 | 356 | 389 | 421 | 623 | 785 | 804 | 828 | 857 | 876 |
| Maint. Of Infrastructure | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 85 | 114 | 135 | 137 | 106 | 89 |
| Stations | - | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | 18 | 20 | 23 | 26 | 29 | 41 | 46 | 50 | 53 | 79 | 98 | 102 | 105 | 105 | 105 |
| Contingency | - | - | 20 | 22 | 26 | 29 | 32 | 45 | 51 | 55 | 58 | 87 | 108 | 113 | 115 | 115 | 115 |
| Caltrain Fare Reimbursement | - | - | 12 | 16 | 20 | 24 | 28 | 37 | 41 | 46 | 51 | - | - | - | - | - | - |
| Start-up Training | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 134 | 208 | 323 | 382 | 459 | 536 | 609 | 887 | 1,020 | 1,133 | 1,251 | 2,007 | 2,889 | 3,485 | 4,142 | 4,790 | 5,569 |

**MEDIUM RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 08**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | 3.7 | 4.9 | 6.1 | 7.3 | 8.6 | 12.6 | 14.2 | 15.8 | 17.5 | 28.5 | 36.8 | 37.7 | 38.7 | 39.7 | 40.7 |
| **Revenue (in 2010 $$)** | - | - | 244 | 323 | 404 | 487 | 571 | 921 | 1,039 | 1,158 | 1,280 | 1,760 | 2,271 | 2,329 | 2,387 | 2,448 | 2,509 |
| **Revenue (in YoE $$)** | - | - | 347 | 474 | 611 | 759 | 917 | 1,523 | 1,768 | 2,031 | 2,312 | 3,685 | 5,513 | 6,552 | 7,788 | 9,256 | 11,001 |
| **O&M Costs (in 2010 $$)** | 100 | 150 | 207 | 235 | 266 | 304 | 343 | 459 | 512 | 550 | 591 | 836 | 1,041 | 1,076 | 1,091 | 1,063 | 1,093 |
| Ops. and Maint. Of Equipment | - | - | 82 | 102 | 125 | 154 | 183 | 250 | 290 | 316 | 344 | 521 | 662 | 670 | 681 | 688 | 730 |
| Maint. Of Infrastructure | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 85 | 114 | 135 | 137 | 106 | 89 |
| Stations | - | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | 16 | 18 | 21 | 23 | 26 | 35 | 39 | 42 | 45 | 69 | 86 | 89 | 90 | 88 | 90 |
| Contingency | - | - | 18 | 20 | 23 | 26 | 29 | 39 | 43 | 46 | 50 | 76 | 95 | 98 | 99 | 97 | 99 |
| Caltrain Fare Reimbursement | - | - | 10 | 13 | 17 | 20 | 24 | 31 | 35 | 39 | 43 | - | - | - | - | - | - |
| Start-up Training | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 134 | 208 | 295 | 344 | 402 | 474 | 550 | 759 | 872 | 964 | 1,067 | 1,750 | 2,528 | 3,028 | 3,560 | 4,019 | 4,790 |

**LOW RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 09**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | 3.0 | 4.0 | 4.9 | 5.9 | 6.9 | 10.2 | 11.4 | 12.8 | 14.1 | 23.0 | 29.7 | 30.4 | 31.2 | 32.0 | 32.8 |
| **Revenue (in 2010 $$)** | - | - | 201 | 264 | 328 | 394 | 461 | 743 | 837 | 933 | 1,032 | 1,418 | 1,831 | 1,877 | 1,924 | 1,973 | 2,023 |
| **Revenue (in YoE $$)** | - | - | 286 | 388 | 496 | 613 | 739 | 1,227 | 1,425 | 1,637 | 1,863 | 2,970 | 4,443 | 5,281 | 6,277 | 7,460 | 8,867 |
| **O&M Costs (in 2010 $$)** | 100 | 150 | 192 | 208 | 242 | 261 | 296 | 405 | 440 | 459 | 517 | 722 | 896 | 950 | 962 | 924 | 923 |
| Ops. and Maint. Of Equipment | - | - | 71 | 82 | 108 | 121 | 148 | 210 | 235 | 247 | 290 | 428 | 542 | 566 | 574 | 574 | 590 |
| Maint. Of Infrastructure | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 85 | 114 | 135 | 137 | 106 | 89 |
| Stations | - | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | 15 | 16 | 19 | 20 | 23 | 31 | 34 | 35 | 40 | 60 | 74 | 79 | 80 | 76 | 76 |
| Contingency | - | - | 17 | 18 | 21 | 22 | 25 | 35 | 37 | 39 | 44 | 66 | 81 | 86 | 87 | 84 | 84 |
| Caltrain Fare Reimbursement | - | - | 8 | 11 | 14 | 16 | 19 | 25 | 28 | 31 | 34 | - | - | - | - | - | - |
| Start-up Training | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 134 | 208 | 274 | 305 | 366 | 406 | 475 | 669 | 749 | 805 | 934 | 1,512 | 2,174 | 2,673 | 3,138 | 3,494 | 4,048 |

YoE = Year of Expenditure, inflation rate of 3% per annum

## IOS NORTH - UNCONSTRAINED CONSTRUCTION SCHEDULE - LOW CONSTRUCTION COSTS

**HIGH, MEDIUM, AND LOW RIDERSHIP, REVENUE, AND OPERATING AND MAINTENANCE COSTS**
**SCENARIOS 10, 11, AND 12**

**SERVICE PARAMETERS**

| | Route Miles | Revenue Service Start | HST Trainset Miles (in millions per year) | | | Dedicated Coach Hours (in millions per year) | | |
|---|---|---|---|---|---|---|---|---|
| | | | High | Medium | Low | High | Medium | Low |
| IOS North | 300 | 2021 | 7.8 | 6.6 | 5.6 | 0.8 | 0.6 | 0.5 |
| Bay to Basin | 450 | 2026 | 21.8 | 18.1 | 14.8 | 0.3 | 0.2 | 0.2 |
| Phase 1 | 540 | 2034 | 36.9 | 31.1 | 25.6 | 0.3 | 0.2 | 0.2 |

Note: HST Trainset Miles and Dedicated Coach Hours are for Year 2040

**HIGH RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 10**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | **-** | **4.3** | **5.7** | **7.2** | **8.7** | **10.2** | **14.9** | **16.8** | **18.7** | **20.7** | **22.7** | **34.0** | **43.9** | **45.0** | **46.2** | **47.4** | **48.5** |
| **Revenue (in 2010 $$)** | **-** | **283** | **379** | **476** | **575** | **676** | **1,089** | **1,228** | **1,369** | **1,513** | **1,660** | **2,101** | **2,712** | **2,780** | **2,851** | **2,923** | **2,996** |
| **Revenue (in YoE $$)** | **-** | **392** | **540** | **698** | **869** | **1,052** | **1,748** | **2,030** | **2,331** | **2,653** | **2,998** | **4,400** | **6,583** | **7,824** | **9,299** | **11,052** | **13,136** |
| **O&M Costs (in 2010 $$)** | **150** | **216** | **259** | **303** | **341** | **368** | **536** | **564** | **640** | **670** | **750** | **967** | **1,196** | **1,240** | **1,263** | **1,259** | **1,271** |
| Ops. and Maint. Of Equipment | - | 88 | 121 | 154 | 182 | 201 | 309 | 328 | 384 | 403 | 461 | 623 | 785 | 804 | 828 | 857 | 876 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 17 | 20 | 23 | 26 | 28 | 41 | 43 | 49 | 51 | 57 | 80 | 99 | 103 | 104 | 104 | 105 |
| Contingency | - | 19 | 22 | 26 | 29 | 31 | 45 | 48 | 54 | 56 | 63 | 88 | 109 | 113 | 115 | 114 | 116 |
| Caltrain Fare Reimbursement | - | 12 | 16 | 20 | 24 | 28 | 36 | 41 | 46 | 50 | 55 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | **202** | **299** | **370** | **445** | **516** | **574** | **861** | **933** | **1,089** | **1,174** | **1,354** | **2,026** | **2,903** | **3,490** | **4,119** | **4,763** | **5,570** |

**MEDIUM RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 11**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | **-** | **3.6** | **4.8** | **6.0** | **7.3** | **8.5** | **12.5** | **14.1** | **15.7** | **17.3** | **19.0** | **28.5** | **36.8** | **37.7** | **38.7** | **39.7** | **40.7** |
| **Revenue (in 2010 $$)** | **-** | **241** | **320** | **400** | **482** | **566** | **912** | **1,028** | **1,147** | **1,267** | **1,390** | **1,760** | **2,271** | **2,329** | **2,387** | **2,448** | **2,509** |
| **Revenue (in YoE $$)** | **-** | **334** | **456** | **588** | **729** | **881** | **1,464** | **1,700** | **1,952** | **2,222** | **2,511** | **3,685** | **5,513** | **6,552** | **7,788** | **9,256** | **11,001** |
| **O&M Costs (in 2010 $$)** | **150** | **207** | **234** | **265** | **300** | **337** | **459** | **494** | **549** | **589** | **644** | **845** | **1,047** | **1,078** | **1,084** | **1,055** | **1,093** |
| Ops. and Maint. Of Equipment | - | 82 | 102 | 125 | 150 | 179 | 250 | 275 | 316 | 343 | 381 | 521 | 662 | 670 | 681 | 688 | 730 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 16 | 18 | 21 | 23 | 26 | 35 | 38 | 42 | 45 | 49 | 70 | 87 | 89 | 90 | 87 | 90 |
| Contingency | - | 18 | 20 | 23 | 25 | 29 | 39 | 42 | 46 | 50 | 54 | 77 | 95 | 98 | 99 | 96 | 99 |
| Caltrain Fare Reimbursement | - | 10 | 13 | 17 | 20 | 24 | 30 | 34 | 38 | 42 | 46 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | **202** | **286** | **334** | **390** | **453** | **526** | **737** | **817** | **935** | **1,034** | **1,164** | **1,769** | **2,542** | **3,033** | **3,537** | **3,991** | **4,791** |

**LOW RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 12**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | **-** | **3.0** | **3.9** | **4.9** | **5.9** | **6.9** | **10.1** | **11.3** | **12.6** | **14.0** | **15.3** | **23.0** | **29.7** | **30.4** | **31.2** | **32.0** | **32.8** |
| **Revenue (in 2010 $$)** | **-** | **199** | **261** | **325** | **390** | **456** | **735** | **829** | **924** | **1,021** | **1,121** | **1,418** | **1,831** | **1,877** | **1,924** | **1,973** | **2,023** |
| **Revenue (in YoE $$)** | **-** | **275** | **373** | **477** | **590** | **710** | **1,180** | **1,370** | **1,573** | **1,791** | **2,024** | **2,970** | **4,443** | **5,281** | **6,277** | **7,460** | **8,867** |
| **O&M Costs (in 2010 $$)** | **150** | **189** | **208** | **231** | **255** | **296** | **404** | **439** | **458** | **496** | **554** | **731** | **902** | **952** | **955** | **917** | **924** |
| Ops. and Maint. Of Equipment | - | 69 | 82 | 99 | 117 | 148 | 210 | 235 | 247 | 272 | 314 | 428 | 542 | 566 | 574 | 574 | 590 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 25 | 25 | 25 | 25 | 25 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 15 | 16 | 18 | 20 | 23 | 31 | 34 | 35 | 38 | 43 | 60 | 75 | 79 | 79 | 76 | 76 |
| Contingency | - | 16 | 18 | 20 | 22 | 25 | 35 | 37 | 39 | 42 | 47 | 66 | 82 | 87 | 87 | 83 | 84 |
| Caltrain Fare Reimbursement | - | 8 | 11 | 14 | 16 | 19 | 24 | 28 | 31 | 34 | 37 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | **202** | **262** | **296** | **339** | **385** | **461** | **649** | **726** | **780** | **870** | **1,001** | **1,531** | **2,188** | **2,678** | **3,115** | **3,466** | **4,049** |

YoE = Year of Expenditure, inflation rate of 3% per annum

## IOS SOUTH - CONSTRAINED CONSTRUCTION SCHEDULE - HIGH CONSTRUCTION COSTS

**HIGH, MEDIUM, AND LOW RIDERSHIP, REVENUE, AND OPERATING AND MAINTENANCE COSTS**
**SCENARIOS 13, 14, AND 15**

**SERVICE PARAMETERS**

| | Route Miles | Revenue Service Start | HST Trainset Miles (in millions per year) | | | Dedicated Coach Hours (in millions per year) | | |
|---|---|---|---|---|---|---|---|---|
| | | | High | Medium | Low | High | Medium | Low |
| IOS South | 300 | 2023 | 10.5 | 9.0 | 7.3 | 1.1 | 0.9 | 0.7 |
| Bay to Basin | 450 | 2028 | 21.8 | 18.1 | 14.8 | 0.3 | 0.2 | 0.2 |
| Phase 1 | 540 | 2039 | 29.9 | 24.4 | 20.6 | 0.2 | 0.2 | 0.1 |

Note: HST Trainset Miles and Dedicated Coach Hours are for Year 2040

**HIGH RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 13**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | - | 5.3 | 7.2 | 9.0 | 11.0 | 12.9 | 16.7 | 18.3 | 19.9 | 23.3 | 34.9 | 45.0 | 46.2 | 47.4 | 48.5 |
| **Revenue (in 2010 $$)** | - | - | - | 376 | 506 | 639 | 774 | 912 | 1,223 | 1,337 | 1,454 | 1,702 | 2,154 | 2,780 | 2,851 | 2,923 | 2,996 |
| **Revenue (in YoE $$)** | - | - | - | 553 | 766 | 996 | 1,243 | 1,508 | 2,082 | 2,345 | 2,626 | 3,563 | 5,229 | 7,824 | 9,299 | 11,052 | 13,136 |
| **O&M Costs (in 2010 $$)** | - | 100 | 150 | 247 | 303 | 347 | 394 | 437 | 542 | 606 | 649 | 778 | 1,004 | 1,230 | 1,267 | 1,272 | 1,271 |
| Ops. and Maint. Of Equipment | - | - | - | 128 | 174 | 210 | 249 | 285 | 310 | 359 | 390 | 468 | 637 | 804 | 828 | 857 | 876 |
| Maint. Of Infrastructure | - | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 69 | 109 | 128 | 135 | 110 | 90 |
| Stations | - | - | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | - | 20 | 25 | 29 | 33 | 36 | 41 | 46 | 50 | 60 | 83 | 102 | 105 | 105 | 105 |
| Contingency | - | - | - | 22 | 28 | 32 | 36 | 40 | 46 | 51 | 55 | 66 | 91 | 112 | 115 | 116 | 116 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | - | - | 41 | 44 | 48 | 57 | - | - | - | - | - |
| Start-up Training | - | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | - | 138 | 214 | 362 | 458 | 540 | 632 | 723 | 923 | 1,062 | 1,172 | 1,629 | 2,436 | 3,461 | 4,132 | 4,810 | 5,573 |

**MEDIUM RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 14**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | - | 4.5 | 6.0 | 7.6 | 9.2 | 10.8 | 14.0 | 15.3 | 16.6 | 19.5 | 29.2 | 37.7 | 38.7 | 39.7 | 40.7 |
| **Revenue (in 2010 $$)** | - | - | - | 319 | 427 | 537 | 650 | 764 | 1,024 | 1,120 | 1,218 | 1,425 | 1,804 | 2,329 | 2,387 | 2,448 | 2,509 |
| **Revenue (in YoE $$)** | - | - | - | 469 | 646 | 837 | 1,043 | 1,263 | 1,744 | 1,964 | 2,199 | 2,984 | 4,379 | 6,552 | 7,788 | 9,256 | 11,001 |
| **O&M Costs (in 2010 $$)** | - | 100 | 150 | 231 | 267 | 310 | 346 | 384 | 463 | 515 | 552 | 681 | 864 | 1,068 | 1,107 | 1,087 | 1,112 |
| Ops. and Maint. Of Equipment | - | - | - | 114 | 145 | 180 | 209 | 241 | 250 | 290 | 316 | 395 | 521 | 670 | 696 | 704 | 745 |
| Maint. Of Infrastructure | - | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 69 | 109 | 128 | 135 | 110 | 90 |
| Stations | - | - | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | - | 19 | 22 | 26 | 29 | 32 | 35 | 39 | 42 | 52 | 71 | 88 | 92 | 90 | 92 |
| Contingency | - | - | - | 21 | 24 | 28 | 31 | 35 | 39 | 43 | 46 | 58 | 79 | 97 | 101 | 99 | 101 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | - | - | 34 | 37 | 41 | 47 | - | - | - | - | - |
| Start-up Training | - | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | - | 138 | 214 | 339 | 404 | 483 | 555 | 635 | 788 | 903 | 996 | 1,425 | 2,098 | 3,005 | 3,612 | 4,110 | 4,877 |

**LOW RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 15**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | - | 3.7 | 4.9 | 6.2 | 7.4 | 8.7 | 11.3 | 12.3 | 13.4 | 15.7 | 23.6 | 30.4 | 31.2 | 32.0 | 32.8 |
| **Revenue (in 2010 $$)** | - | - | - | 262 | 348 | 436 | 525 | 616 | 826 | 903 | 981 | 1,149 | 1,454 | 1,877 | 1,924 | 1,973 | 2,023 |
| **Revenue (in YoE $$)** | - | - | - | 385 | 527 | 679 | 842 | 1,018 | 1,405 | 1,583 | 1,772 | 2,405 | 3,530 | 5,281 | 6,277 | 7,460 | 8,867 |
| **O&M Costs (in 2010 $$)** | - | 100 | 150 | 219 | 230 | 268 | 300 | 335 | 408 | 448 | 469 | 574 | 764 | 948 | 966 | 936 | 924 |
| Ops. and Maint. Of Equipment | - | - | - | 104 | 114 | 145 | 172 | 200 | 211 | 241 | 254 | 315 | 439 | 571 | 579 | 579 | 590 |
| Maint. Of Infrastructure | - | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 69 | 109 | 128 | 135 | 110 | 90 |
| Stations | - | - | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | - | 18 | 19 | 22 | 25 | 28 | 31 | 35 | 36 | 44 | 63 | 78 | 80 | 77 | 76 |
| Contingency | - | - | - | 20 | 21 | 24 | 27 | 30 | 35 | 38 | 40 | 49 | 69 | 86 | 88 | 85 | 84 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | - | - | 27 | 30 | 33 | 38 | - | - | - | - | - |
| Start-up Training | - | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | - | 138 | 214 | 321 | 348 | 417 | 481 | 553 | 695 | 786 | 847 | 1,203 | 1,855 | 2,668 | 3,151 | 3,539 | 4,052 |

YoE = Year of Expenditure, inflation rate of 3% per annum

## IOS SOUTH - UNCONSTRAINED CONSTRUCTION SCHEDULE - HIGH CONSTRUCTION COSTS

**HIGH, MEDIUM, AND LOW RIDERSHIP, REVENUE, AND OPERATING AND MAINTENANCE COSTS**

**SCENARIOS 16, 17, AND 18**

**SERVICE PARAMETERS**

| | Route Miles | Revenue Service Start | HST Trainset Miles (in millions per year) | | | Dedicated Coach Hours (in millions per year) | | |
|---|---|---|---|---|---|---|---|---|
| | | | High | Medium | Low | High | Medium | Low |
| IOS South | 300 | 2021 | 10.5 | 9.0 | 7.3 | 1.1 | 0.9 | 0.7 |
| Bay to Basin | 450 | 2026 | 21.8 | 18.1 | 14.8 | 0.3 | 0.2 | 0.2 |
| Phase 1 | 540 | 2034 | 36.9 | 31.1 | 25.6 | 0.3 | 0.2 | 0.2 |

Note: HST Trainset Miles and Dedicated Coach Hours are for Year 2040

**HIGH RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 16**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | 5.2 | 7.0 | 8.9 | 10.7 | 12.7 | 16.4 | 17.9 | 19.5 | 21.1 | 22.7 | 34.0 | 43.9 | 45.0 | 46.2 | 47.4 | 48.5 |
| **Revenue (in 2010 $$)** | - | 369 | 497 | 627 | 759 | 894 | 1,199 | 1,311 | 1,425 | 1,541 | 1,660 | 2,101 | 2,712 | 2,780 | 2,851 | 2,923 | 2,996 |
| **Revenue (in YoE $$)** | - | 511 | 708 | 920 | 1,148 | 1,393 | 1,924 | 2,167 | 2,426 | 2,703 | 2,998 | 4,400 | 6,583 | 7,824 | 9,299 | 11,052 | 13,136 |
| **O&M Costs (in 2010 $$)** | 150 | 243 | 290 | 347 | 389 | 436 | 562 | 613 | 655 | 678 | 750 | 967 | 1,196 | 1,240 | 1,263 | 1,259 | 1,271 |
| Ops. and Maint. Of Equipment | - | 125 | 164 | 210 | 245 | 284 | 327 | 365 | 395 | 409 | 461 | 623 | 785 | 804 | 828 | 857 | 876 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 20 | 24 | 29 | 32 | 36 | 43 | 47 | 50 | 52 | 57 | 80 | 99 | 103 | 104 | 104 | 105 |
| Contingency | - | 22 | 26 | 32 | 35 | 40 | 47 | 52 | 55 | 57 | 63 | 88 | 109 | 113 | 115 | 114 | 116 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | 40 | 44 | 47 | 51 | 55 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 202 | 337 | 414 | 509 | 589 | 679 | 901 | 1,012 | 1,115 | 1,190 | 1,354 | 2,026 | 2,903 | 3,490 | 4,119 | 4,763 | 5,570 |

**MEDIUM RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 17**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | 4.4 | 5.9 | 7.5 | 9.0 | 10.6 | 13.7 | 15.0 | 16.3 | 17.7 | 19.0 | 28.5 | 36.8 | 37.7 | 38.7 | 39.7 | 40.7 |
| **Revenue (in 2010 $$)** | - | 313 | 419 | 527 | 637 | 749 | 1,004 | 1,098 | 1,194 | 1,291 | 1,390 | 1,760 | 2,271 | 2,329 | 2,387 | 2,448 | 2,509 |
| **Revenue (in YoE $$)** | - | 433 | 597 | 774 | 963 | 1,167 | 1,611 | 1,815 | 2,032 | 2,264 | 2,511 | 3,685 | 5,513 | 6,552 | 7,788 | 9,256 | 11,001 |
| **O&M Costs (in 2010 $$)** | 150 | 218 | 266 | 310 | 346 | 384 | 492 | 538 | 558 | 591 | 644 | 845 | 1,047 | 1,078 | 1,103 | 1,074 | 1,112 |
| Ops. and Maint. Of Equipment | - | 104 | 144 | 180 | 209 | 241 | 275 | 309 | 322 | 344 | 381 | 521 | 662 | 670 | 696 | 704 | 745 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 18 | 22 | 26 | 29 | 32 | 38 | 41 | 43 | 45 | 49 | 70 | 87 | 89 | 91 | 89 | 92 |
| Contingency | - | 20 | 24 | 28 | 31 | 35 | 42 | 46 | 47 | 50 | 54 | 77 | 95 | 98 | 100 | 98 | 101 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | 33 | 37 | 40 | 43 | 46 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 202 | 302 | 379 | 455 | 523 | 598 | 790 | 889 | 951 | 1,036 | 1,164 | 1,769 | 2,542 | 3,033 | 3,599 | 4,063 | 4,875 |

**LOW RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 18**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | 3.6 | 4.8 | 6.0 | 7.3 | 8.5 | 11.1 | 12.1 | 13.2 | 14.2 | 15.3 | 23.0 | 29.7 | 30.4 | 31.2 | 32.0 | 32.8 |
| **Revenue (in 2010 $$)** | - | 257 | 341 | 427 | 515 | 604 | 809 | 885 | 962 | 1,040 | 1,121 | 1,418 | 1,831 | 1,877 | 1,924 | 1,973 | 2,023 |
| **Revenue (in YoE $$)** | - | 356 | 487 | 627 | 778 | 941 | 1,299 | 1,463 | 1,638 | 1,825 | 2,024 | 2,970 | 4,443 | 5,281 | 6,277 | 7,460 | 8,867 |
| **O&M Costs (in 2010 $$)** | 150 | 183 | 230 | 262 | 293 | 328 | 430 | 455 | 468 | 518 | 555 | 731 | 902 | 952 | 955 | 917 | 917 |
| Ops. and Maint. Of Equipment | - | 75 | 114 | 140 | 166 | 195 | 229 | 247 | 254 | 290 | 315 | 428 | 542 | 566 | 574 | 574 | 584 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 15 | 19 | 22 | 24 | 27 | 33 | 35 | 36 | 40 | 43 | 60 | 75 | 79 | 79 | 76 | 76 |
| Contingency | - | 17 | 21 | 24 | 27 | 30 | 37 | 39 | 40 | 44 | 47 | 66 | 82 | 87 | 87 | 83 | 83 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | 27 | 29 | 32 | 35 | 37 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 202 | 254 | 328 | 384 | 444 | 511 | 690 | 752 | 797 | 908 | 1,002 | 1,531 | 2,188 | 2,678 | 3,115 | 3,466 | 4,020 |

YoE = Year of Expenditure, inflation rate of 3% per annum

## IOS SOUTH - CONSTRAINED CONSTRUCTION SCHEDULE - LOW CONSTRUCTION COSTS

**HIGH, MEDIUM, AND LOW RIDERSHIP, REVENUE, AND OPERATING AND MAINTENANCE COSTS**
**SCENARIOS 19, 20, AND 21**

**SERVICE PARAMETERS**

| | Route Miles | Revenue Service Start | HST Trainset Miles (in millions per year) | | | Dedicated Coach Hours (in millions per year) | | |
|---|---|---|---|---|---|---|---|---|
| | | | High | Medium | Low | High | Medium | Low |
| IOS South | 300 | 2022 | 10.5 | 9.0 | 7.3 | 1.1 | 0.9 | 0.7 |
| Bay to Basin | 450 | 2027 | 21.8 | 18.1 | 14.8 | 0.3 | 0.2 | 0.2 |
| Phase 1 | 540 | 2034 | 36.9 | 31.1 | 25.6 | 0.3 | 0.2 | 0.2 |

Note: HSR Trainset Miles and Dedicated Coach Hours are for Year 2040

**HIGH RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 19**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | 5.3 | 7.1 | 9.0 | 10.8 | 12.8 | 16.6 | 18.1 | 19.7 | 21.3 | 34.0 | 43.9 | 45.0 | 46.2 | 47.4 | 48.5 |
| **Revenue (in 2010 $$)** | - | - | 373 | 501 | 633 | 767 | 903 | 1,211 | 1,324 | 1,439 | 1,557 | 2,101 | 2,712 | 2,780 | 2,851 | 2,923 | 2,996 |
| **Revenue (in YoE $$)** | - | - | 531 | 736 | 957 | 1,195 | 1,450 | 2,001 | 2,254 | 2,524 | 2,812 | 4,400 | 6,583 | 7,824 | 9,299 | 11,052 | 13,136 |
| **O&M Costs (in 2010 $$)** | 100 | 150 | 243 | 303 | 347 | 393 | 437 | 563 | 613 | 656 | 685 | 958 | 1,190 | 1,239 | 1,270 | 1,267 | 1,270 |
| Ops. and Maint. Of Equipment | - | - | 125 | 174 | 210 | 249 | 285 | 328 | 365 | 396 | 414 | 623 | 785 | 804 | 828 | 857 | 876 |
| Maint. Of Infrastructure | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 85 | 114 | 135 | 137 | 106 | 89 |
| Stations | - | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | 20 | 25 | 29 | 32 | 36 | 43 | 47 | 50 | 52 | 79 | 98 | 102 | 105 | 105 | 105 |
| Contingency | - | - | 22 | 28 | 32 | 36 | 40 | 47 | 52 | 55 | 58 | 87 | 108 | 113 | 115 | 115 | 115 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | - | 40 | 44 | 48 | 52 | - | - | - | - | - | - |
| Start-up Training | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 134 | 208 | 347 | 444 | 525 | 612 | 701 | 930 | 1,044 | 1,150 | 1,237 | 2,007 | 2,889 | 3,485 | 4,142 | 4,790 | 5,569 |

**MEDIUM RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 20**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | 4.5 | 6.0 | 7.5 | 9.1 | 10.7 | 13.9 | 15.2 | 16.5 | 17.8 | 28.5 | 36.8 | 37.7 | 38.7 | 39.7 | 40.7 |
| **Revenue (in 2010 $$)** | - | - | 316 | 423 | 532 | 643 | 757 | 1,014 | 1,109 | 1,205 | 1,304 | 1,760 | 2,271 | 2,329 | 2,387 | 2,448 | 2,509 |
| **Revenue (in YoE $$)** | - | - | 451 | 621 | 805 | 1,002 | 1,214 | 1,676 | 1,888 | 2,114 | 2,355 | 3,685 | 5,513 | 6,552 | 7,788 | 9,256 | 11,001 |
| **O&M Costs (in 2010 $$)** | 100 | 150 | 231 | 267 | 310 | 346 | 384 | 493 | 538 | 565 | 614 | 836 | 1,041 | 1,076 | 1,110 | 1,082 | 1,112 |
| Ops. and Maint. Of Equipment | - | - | 114 | 145 | 180 | 209 | 241 | 275 | 309 | 327 | 362 | 521 | 662 | 670 | 696 | 704 | 745 |
| Maint. Of Infrastructure | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 85 | 114 | 135 | 137 | 106 | 89 |
| Stations | - | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | 19 | 22 | 26 | 29 | 32 | 38 | 41 | 43 | 47 | 69 | 86 | 89 | 92 | 89 | 92 |
| Contingency | - | - | 21 | 24 | 28 | 31 | 35 | 42 | 46 | 48 | 52 | 76 | 95 | 98 | 101 | 98 | 101 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | - | 34 | 37 | 40 | 43 | - | - | - | - | - | - |
| Start-up Training | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 134 | 208 | 329 | 392 | 469 | 539 | 617 | 815 | 916 | 990 | 1,109 | 1,750 | 2,528 | 3,028 | 3,622 | 4,091 | 4,873 |

**LOW RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 21**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | - | 3.7 | 4.9 | 6.1 | 7.4 | 8.6 | 11.2 | 12.2 | 13.3 | 14.4 | 23.0 | 29.7 | 30.4 | 31.2 | 32.0 | 32.8 |
| **Revenue (in 2010 $$)** | - | - | 260 | 345 | 431 | 520 | 610 | 817 | 894 | 972 | 1,051 | 1,418 | 1,831 | 1,877 | 1,924 | 1,973 | 2,023 |
| **Revenue (in YoE $$)** | - | - | 370 | 506 | 652 | 810 | 978 | 1,351 | 1,522 | 1,704 | 1,898 | 2,970 | 4,443 | 5,281 | 6,277 | 7,460 | 8,867 |
| **O&M Costs (in 2010 $$)** | 100 | 150 | 188 | 230 | 262 | 294 | 328 | 430 | 455 | 483 | 526 | 722 | 896 | 950 | 962 | 924 | 917 |
| Ops. and Maint. Of Equipment | - | - | 79 | 114 | 140 | 167 | 195 | 229 | 247 | 266 | 296 | 428 | 542 | 566 | 574 | 574 | 584 |
| Maint. Of Infrastructure | - | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 85 | 114 | 135 | 137 | 106 | 89 |
| Stations | - | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | - | 16 | 19 | 22 | 24 | 27 | 33 | 35 | 37 | 41 | 60 | 74 | 79 | 80 | 76 | 76 |
| Contingency | - | - | 17 | 21 | 24 | 27 | 30 | 37 | 39 | 41 | 45 | 66 | 81 | 86 | 87 | 84 | 83 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | - | 27 | 30 | 32 | 35 | - | - | - | - | - | - |
| Start-up Training | 100 | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 134 | 208 | 269 | 338 | 396 | 458 | 526 | 711 | 775 | 848 | 949 | 1,512 | 2,174 | 2,673 | 3,138 | 3,494 | 4,018 |

YoE = Year of Expenditure, inflation rate of 3% per annum

## IOS SOUTH - UNCONSTRAINED CONSTRUCTION SCHEDULE - LOW CONSTRUCTION COSTS

**HIGH, MEDIUM, AND LOW RIDERSHIP, REVENUE, AND OPERATING AND MAINTENANCE COSTS**
**SCENARIOS 22, 23, AND 24**

**SERVICE PARAMETERS**

| | Route Miles | Revenue Service Start | HST Trainset Miles (in millions per year) | | | Dedicated Coach Hours (in millions per year) | | |
|---|---|---|---|---|---|---|---|---|
| | | | High | Medium | Low | High | Medium | Low |
| IOS South | 300 | 2021 | 10.5 | 9.0 | 7.3 | 1.1 | 0.9 | 0.7 |
| Bay to Basin | 450 | 2026 | 21.8 | 18.1 | 14.8 | 0.3 | 0.2 | 0.2 |
| Phase 1 | 540 | 2034 | 36.9 | 31.1 | 25.6 | 0.3 | 0.2 | 0.2 |

Note: HSR Trainset Miles and Dedicated Coach Hours are for Year 2040

**HIGH RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 22**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | 5.2 | 7.0 | 8.9 | 10.7 | 12.7 | 16.4 | 17.9 | 19.5 | 21.1 | 22.7 | 34.0 | 43.9 | 45.0 | 46.2 | 47.4 | 48.5 |
| **Revenue (in 2010 $$)** | - | 369 | 497 | 627 | 759 | 894 | 1,199 | 1,311 | 1,425 | 1,541 | 1,660 | 2,101 | 2,712 | 2,780 | 2,851 | 2,923 | 2,996 |
| **Revenue (in YoE $$)** | - | 511 | 708 | 920 | 1,148 | 1,393 | 1,924 | 2,167 | 2,426 | 2,703 | 2,998 | 4,400 | 6,583 | 7,824 | 9,299 | 11,052 | 13,136 |
| **O&M Costs (in 2010 $$)** | 150 | 243 | 290 | 347 | 389 | 436 | 562 | 613 | 655 | 678 | 750 | 967 | 1,196 | 1,240 | 1,263 | 1,259 | 1,271 |
| Ops. and Maint. Of Equipment | - | 125 | 164 | 210 | 245 | 284 | 327 | 365 | 395 | 409 | 461 | 623 | 785 | 804 | 828 | 857 | 876 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 20 | 24 | 29 | 32 | 36 | 43 | 47 | 50 | 52 | 57 | 80 | 99 | 103 | 104 | 104 | 105 |
| Contingency | - | 22 | 26 | 32 | 35 | 40 | 47 | 52 | 55 | 57 | 63 | 88 | 109 | 113 | 115 | 114 | 116 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | 40 | 44 | 47 | 51 | 55 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 202 | 337 | 414 | 509 | 589 | 679 | 901 | 1,012 | 1,115 | 1,190 | 1,354 | 2,026 | 2,903 | 3,490 | 4,119 | 4,763 | 5,570 |

**MEDIUM RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 23**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | 4.4 | 5.9 | 7.5 | 9.0 | 10.6 | 13.7 | 15.0 | 16.3 | 17.7 | 19.0 | 28.5 | 36.8 | 37.7 | 38.7 | 39.7 | 40.7 |
| **Revenue (in 2010 $$)** | - | 313 | 419 | 527 | 637 | 749 | 1,004 | 1,098 | 1,194 | 1,291 | 1,390 | 1,760 | 2,271 | 2,329 | 2,387 | 2,448 | 2,509 |
| **Revenue (in YoE $$)** | - | 433 | 597 | 774 | 963 | 1,167 | 1,611 | 1,815 | 2,032 | 2,264 | 2,511 | 3,685 | 5,513 | 6,552 | 7,788 | 9,256 | 11,001 |
| **O&M Costs (in 2010 $$)** | 150 | 218 | 266 | 310 | 346 | 384 | 492 | 538 | 558 | 591 | 644 | 845 | 1,047 | 1,078 | 1,103 | 1,074 | 1,112 |
| Ops. and Maint. Of Equipment | - | 104 | 144 | 180 | 209 | 241 | 275 | 309 | 322 | 344 | 381 | 521 | 662 | 670 | 696 | 704 | 745 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 18 | 22 | 26 | 29 | 32 | 38 | 41 | 43 | 45 | 49 | 70 | 87 | 89 | 91 | 89 | 92 |
| Contingency | - | 20 | 24 | 28 | 31 | 35 | 42 | 46 | 47 | 50 | 54 | 77 | 95 | 98 | 100 | 98 | 101 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | 33 | 37 | 40 | 43 | 46 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 202 | 302 | 379 | 455 | 523 | 598 | 790 | 889 | 951 | 1,036 | 1,164 | 1,769 | 2,542 | 3,033 | 3,599 | 4,063 | 4,875 |

**LOW RIDERSHIP, REVENUE, AND O&M COSTS - Scenario 24**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ridership (in millions)** | - | 3.6 | 4.8 | 6.0 | 7.3 | 8.5 | 11.1 | 12.1 | 13.2 | 14.2 | 15.3 | 23.0 | 29.7 | 30.4 | 31.2 | 32.0 | 32.8 |
| **Revenue (in 2010 $$)** | - | 257 | 341 | 427 | 515 | 604 | 809 | 885 | 962 | 1,040 | 1,121 | 1,418 | 1,831 | 1,877 | 1,924 | 1,973 | 2,023 |
| **Revenue (in YoE $$)** | - | 356 | 487 | 627 | 778 | 941 | 1,299 | 1,463 | 1,638 | 1,825 | 2,024 | 2,970 | 4,443 | 5,281 | 6,277 | 7,460 | 8,867 |
| **O&M Costs (in 2010 $$)** | 150 | 183 | 230 | 262 | 293 | 328 | 430 | 455 | 468 | 518 | 555 | 731 | 902 | 952 | 955 | 917 | 917 |
| Ops. and Maint. Of Equipment | - | 75 | 114 | 140 | 166 | 195 | 229 | 247 | 254 | 290 | 315 | 428 | 542 | 566 | 574 | 574 | 584 |
| Maint. Of Infrastructure | - | 30 | 30 | 30 | 30 | 30 | 45 | 46 | 48 | 51 | 54 | 93 | 119 | 136 | 131 | 100 | 90 |
| Stations | - | 21 | 21 | 21 | 21 | 21 | 34 | 34 | 34 | 34 | 34 | 59 | 59 | 59 | 59 | 59 | 59 |
| Insurance | - | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| General and Administration | - | 15 | 19 | 22 | 24 | 27 | 33 | 35 | 36 | 40 | 43 | 60 | 75 | 79 | 79 | 76 | 76 |
| Contingency | - | 17 | 21 | 24 | 27 | 30 | 37 | 39 | 40 | 44 | 47 | 66 | 82 | 87 | 87 | 83 | 83 |
| Caltrain Fare Reimbursement | - | - | - | - | - | - | 27 | 29 | 32 | 35 | 37 | - | - | - | - | - | - |
| Start-up Training | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **O&M Costs (in YoE $$)** | 202 | 254 | 328 | 384 | 444 | 511 | 690 | 752 | 797 | 908 | 1,002 | 1,531 | 2,188 | 2,678 | 3,115 | 3,466 | 4,020 |

YoE = Year of Expenditure, inflation rate of 3% per annum